

CHECKOUT DEVICE INCLUDING SCAN PATTERN-SHIFTING ELEMENT

Background of the Invention

The present invention relates to product checkout devices and more specifically to a checkout device including a scan pattern-shifting element.

Common checkout devices include combinations of barcode scanners and scale assemblies. One example of such a checkout device is the NCR 7875 checkout device.

Another example of a checkout device includes a barcode scanner and an integrated electronic article surveillance (EAS) system and is illustrated in U.S. Patent 5,059,951.

Typical EAS systems must be positioned in a bar code scanner as close as possible to scanned item. In order to accommodate installation of an EAS system, mirrors and possibly other scanner components must be lowered to a less than optimal location in the scanner housing.

Therefore, it would be desirable to produce a checkout device that includes a lens for moving the scan pattern to a more effective location above the checkout device.

Summary of the Invention

In accordance with the teachings of the present invention, a checkout device including a scan pattern-shifting element is provided.

A checkout device including an element for shifting a scan pattern to an effective location for scanning. In addition to the optical element, the checkout device includes a bar code reader. The bar code reader includes a housing having an aperture for emitting scanning light beams. The checkout device further includes a security

system in the housing and adjacent the aperture for deactivating security labels on scanned items.

It is accordingly an object of the present invention to provide a checkout device including a scan pattern-shifting element.

It is another object of the present invention to provide a checkout device including a bar code scanner, scale assembly, and integral electronic article surveillance (EAS) system, without sacrificing performance of the bar code scanner or the EAS system.

Brief Description of the Drawings

Additional benefits and advantages of the present invention will become apparent to those skilled in the art to which this invention relates from the subsequent description of the preferred embodiments and the appended claims, taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a block diagram of an example checkout system;

Fig. 2 is a perspective view of the checkout device with the scale weigh plate removed;

Fig. 3 is a diagrammatic view illustrating operation of the pattern-shifting element;

Fig. 4 is a view of a scan pattern from an unmodified scanner;

Fig. 5 is a view of a scan pattern from a scanner modified by lowering the pattern-generating elements to accommodate installation of an EAS system; and

Fig. 6 is a view of a scan pattern from the scanner of Fig. 5 additionally modified to include a pattern-shifting element.

Detailed Description of the Preferred Embodiment

Referring now to Fig. 1, checkout system 10 primarily includes checkout device 12 and point-of-sale (POS) terminal 14.

Checkout device 12 primarily includes barcode scanner 20, scale assembly 22, and electronic article surveillance (EAS) system 24.

Bar code scanner 20 reads barcode labels 42 on purchased items 50. Barcode scanner 20 may include a single aperture or multi-aperture scanner, such as the NCR model 7876 barcode scanner.

Bar code scanner 20 may include laser 30, pattern-generating elements 32, photodetector 34, and control circuitry 36.

Laser 30 produces a laser beam.

Pattern-generating elements 32 include mirrors for reflecting the laser beam to produce scanning light beams, which emanate through aperture 46. Pattern-generating elements 32 may include a rotating mirrored polygon spinner and a plurality of pattern mirrors oriented at different angles for scattering the laser beam in different directions.

Photodetector 34 converts light reflected from item 50 into electrical signals.

Control circuitry 36 controls operation of bar code reader 20 and also decodes bar code information in the electrical signals.

Pattern-shifting element 38 optically moves the scanning light beams to an effective location, one more optimally suited for reading bar code labels 42. Pattern-shifting element 38 is preferably a glass block which is located above the pattern-generating elements 32.

One application of pattern-shifting element 38 is to accommodate retrofit installation of EAS system 24 into a checkout device or bar code scanner not originally designed to include EAS system 24 (Fig. 2).

Scale assembly 22 weighs purchased produce items and may include a load cell. Aperture 46 is part of scale weigh plate 48.

EAS system 24 deactivates security labels 44 on purchased items 50 that have them. EAS system 24 is mounted in close proximity to aperture 46 to facilitate reading of bar code label 42 and deactivation of security label 44 during a single scanning motion across checkout device 12. Aperture 46 may be located in a surface of housing 40 or within a scale assembly weigh plate of scale assembly 22.

POS terminal 14 records items for purchase and records payment for the items. POS terminal 14 obtains item identification information from bar code scanner 20 of checkout device 12. POS terminal 14 obtains price information from transaction server 16.

With reference to Fig. 2, an example checkout device 12 is shown. The example checkout device includes horizontal aperture 46 in horizontal portion 56 and vertical aperture 54 in vertical portion 58.

Pattern-shifting element 38 sits on pattern-generating elements 32. In this example, pattern-generating elements 32 were originally designed for use in a checkout device without EAS system 24. In order to accommodate installation

of EAS system 24 in an optimal position close to aperture 46, pattern-generating elements 32 were lowered to a less than optimal position in horizontal portion 56 for scanning item 50. The new position is lower than the original position by about the thickness of pattern-shifting element 38. Pattern-shifting element 38 compensates for this mounting location by shifting the scan pattern so that it more closely resembles the original scan pattern.

EAS system 24 may include a magnetic coil 52 packaged to look substantially like a brick. Magnetic coil 52 is mounted close to aperture 46 and adjacent to pattern-shifting element 38.

Scale weigh plate 48 acts as a cover for horizontal portion 56.

With reference to Fig. 3, operation of pattern-shifting element 38 is illustrated.

Pattern-shifting element 38 relies on Snell's Law:

$$n_1 \cdot \sin \theta_1 = n_2 \cdot \sin \theta_2,$$

where n_1 is the refractive index of air ($n_1 = 1$), n_2 is the refractive index of pattern-shifting element 38, θ_1 is the angle of incidence of a input scanning laser beam L_{in} and the angle of refraction of output scanning laser beam L_{out} , and θ_2 is angle of refraction in pattern-shifting element 38.

For example, suppose that pattern-shifting element 38 is made of glass with an index of refraction n_2 of 1.5. Further suppose that incident angle θ_1 is 45 degrees, and the thickness t of pattern-shifting element 38 is 1.75 inches.

The refractive angle θ_2 is

$$\theta_2 = \sin^{-1} \left(\frac{n_1}{n_2} \cdot \sin \theta_1 \right), \text{ or } 28.13 \text{ degrees.}$$

Therefore, the beam shift within pattern-shifting element 38 is

$$y - x = t \cdot \tan \theta_1 - t \cdot \tan \theta_2, \text{ or } 0.81 \text{ inches.}$$

Turning now to Figs. 4-6, beam patterns are shown for comparison.

With reference to Fig. 4, the scan pattern from the horizontal aperture 46 of an NCR 7876 bar code scanner without modification to accommodate EAS system 24 is shown. Table 1 identifies the side scanned by each of the scan line pairs.

<u>Scan Line Pair</u>	<u>Sides Scanned</u>
70, 72	Bottom, Intermediate Bottom Customer
74, 76	Bottom, Checker
78, 80	Bottom, Checker
82, 84	Bottom, Checker
86, 88	Bottom, Checker, Leading
90, 92	Bottom, Intermediate Bottom Customer
94, 96	Bottom, Checker
98, 100	Bottom, Checker
102, 104	Bottom, Checker
106, 108	Bottom, Checker, Trailing
110, 112	Bottom, Trailing
114, 116	Bottom, Leading

Table I

With reference to Fig. 5, the scan pattern from the horizontal aperture 46 of an NCR 7876 bar code scanner with modification to accommodate EAS system 24 is shown. Although there is no change in the exiting angles of the individual scan lines, the positions of several lines have changed significantly causing many of these lines to exit so close to the vertical window that they are unusable lines unless the barcode is directly on the deck of the scanner.

With reference to Fig. 6, the scan pattern from the horizontal aperture 46 of an NCR 7876 bar code scanner with modification to accommodate EAS system 24 and with pattern-shifting element 38 is shown. There is no change in the exiting angles of the individual scan lines, and the positions of the scan lines are in the usable portion of the exiting window. There is practically no degradation in scanner performance compared to the scan pattern of the unmodified NCR 7876 bar code scanner (Fig. 4).

Although the invention has been described with particular reference to certain preferred embodiments thereof, variations and modifications of the present invention can be effected within the spirit and scope of the following claims.